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FOSSIL ARTHROPODS OF CALIFORNIA

By W. DWIGHT PIERCE

1. INTRODUCTORY STATEMENT

The first true fossil insect described from California was a dragon fly, *Protothore explicata* Cockerell, described from soft blush rock of the Eocene, taken at Phillips' sawmill, five miles south of Montgomery Creek, Shasta County, collected by Ralph W. Chaney. (T. D. A. Cockerell. 1930. A fossil dragon fly from California (Odonata: Calopterygidae). Entom. News 41:49-50, pl. 6). Although we now have other insects to add to the California list, this dragon fly remains the oldest geologically.

Prior to this, however, numerous insects imbedded in the Pleistocene tar deposits of the Rancho La Brea pits in Hancock Park, Los Angeles, were listed by Fordyce Grinnell (1908. Quaternary myriapods and insects. Univ. Calif. Pub., Geology 5:207-215, pls. 15-16), although some of his names were later synonymized by Blaisdell. E. O. Essig (1931. A history of entomology: 3-9) has added a few more species.

The La Brea Pleistocene list is as follows:

Myriapoda

Spirobolus australis Grinnell, fragments.

Coleoptera

Carabidae

Platynus near *funebris* LeConte, a single elytron.
Amara insignis Dejean, two perfect elytra.

Pterostichus sp., several elytra (Grinnell; Essig).
Calosoma semilaeve LeConte, elytron.

Dytiscidae

Dytiscus marginicollis LeConte, two elytra.

Tenebrionidae

Coniontis robusta Horn, one elytron.

Coniontis abdominalis LeConte, two well preserved specimens.

Coniontis puncticollis LeConte, portion of an elytron.

Coniontis elliptica Casey, thorax and elytra.

Eleodes acuticauda LeConte, many specimens (Grinnell; Essig).

Eleodes parvicollis Eschscholtz (*behrii* Grinnell, perfect specimen; *intermedia* Grinnell, complete abdomen and elytra).

Eleodes consobrina LeConte, abdomen and elytra.

Eleodes laticollis LeConte, many good specimens (Grinnell; Essig).

Eleodes grandicollis Eschscholtz (*elongata* Grinnell), single elytron (Grinnell; Essig).

Eleodes omissa LeConte, many specimens (Essig).

Eleodes (?) *distans* Blaisdell, many specimens (Essig).

Cratidus osculans LeConte, two specimens (Essig).

Nyctoporus carinata LeConte, one specimen (Essig).

Eulabis probably *laticornis* Casey, one specimen (Essig).

In the same article Grinnell described two Myriapods:

Julus occidentalis Grinnell, from Samwel Cave, 15 miles from Baird in Shasta County.

Julus cavicola Grinnell, from Potter Creek Cave on the McCloud River, near Baird in Shasta County.

Essig also states that insects have been found in the tar pits at Carpinteria, Santa Barbara County, and at McKittrick, Kern County. Of the latter he mentions delicate Odonata, and the following Coleoptera:

Hydrophilidae

Hydrous triangularis (Say), abundant.
Hydrophilus sp. +, one specimen.

Dytiscidae

Cybister explanatus LeConte, abundant.

To date no extinct species has been found in the tar, except possibly the myriapod. The writer has examined many specimens, and will, later in this series, list the species in the Los Angeles Museum collection from Rancho La Brea.

Essig speaks of the difficulty of recovering Odonata remains. None of these have so far been seen in the La Brea material.

The writer found a rather simple means of cleaning and separating the specimens. They are first soaked for days in gasoline, several changes; then removed to xylol for further removal of the tar. Then if carefully lifted out and dropped into absolute alcohol the last vestige of foreign matter is removed and the specimens are ready for careful mounting. Many fragments of leaves can be recovered in this way. They must be lifted on cover glass and all liquid changes from alcohol to balsam must be done on the glass. Insect chitin is not injured by the whirlpool action taking place when the specimen is plunged into the alcohol.

There are probably other fossil insects in various collections in the state or elsewhere, and we will welcome contributions to this series, two being already promised. This will have the effect of centering knowledge of California fossil insects all in one series of papers. To begin the story there are five specimens in the Los Angeles Museum and two at the University of California. At Dr. Chester Stock's request, a separate title will be given for each source lot described.

It is desired that the contributors to the series give full geological and geographic data regarding their specimens, and that the description be carefully drawn along modern descriptive lines.

2. DESCRIPTION OF A LOWER MIOCENE FOSSIL CARABID BEETLE, WITH A DISCUSSION OF COLEOPTEROUS ELYTRA

There have been very few fossil insects found in America, outside of the coal measures of the Eastern States, the Green River, Wyoming; Florissant, Colorado, and Kansas shales, and the more recent California tar pits. It gave, therefore, quite a thrill when Dr. Lore Rose David, paleontologist of the Richfield Oil Company sent for determination a little beetle elytron from the Cuyama River outcrop section of the upper Lower Miocene, from San Luis Obispo County. This becomes one of the first Miocene insects from California, if our information is complete, and the others are described in the next two papers of this series. The elytron, while broken off at the tip, and cracked in two places can be completely described, because the broken piece, slightly displaced lay just a bit lower and slightly under the major portion. It is exceedingly delicate, but the chitin is well preserved in its original color and texture, and even the tiny setae in the punctures are still present.

The elytron belongs to the Order Coleoptera, Family Carabidae, Tribe Bembidiini, genus *Bembidion,* in which genus one species from White River, Wyoming, Eocene; three species from Florissant, Colorado, Miocene; five species from Scarborough, Ontario, Pleistocene; one from Toronto, Ontario, Pleistocene; and one from Ohio Pleistocene have been described, in addition to many existent species. The genus is therefore over 40 million years old. Our present specimen must be 20 million years old, or older, according to paleontological reckoning. This will be the first fossil specimen in the genus from California, or the Pacific Coast.

Because of the characters of abbreviated scutellar stria, basal extension of the lateral margin, termination of the inflexed lateral area before the tip, and presence of two deeply impressed foveae on the third discal interspace, this fossil elytron must be placed in the great complex genus *Bembidion* Latreille, and according to Casey's 1918 monograph it would fall in group II, or subgenus *Ochthedromus* LeConte. In this subgenus are two California existent species, one *B. (O.) bifossulatum* LeConte being present in the same area as the fossil.

In preparing to study and describe this elytron, the writer had occasion to look up the literature on beetle elytral venation, and was astonished to find that but little had been done to correlate the striae of the elytra with the wing veins, although Comstock in his book, The Wings of Insects, had shown that in the pupa the tracheation for the elytra was homologous with that of the wings.

The Carabidae are the oldest and most primitive beetles, and we should therefore find in this family a rather primitive elytral venation. By a comparative study of the new fossil, and of an elytron from a modern *B. (O.) bifossulatum* the writer feels that it is time to correlate the striae of Carabid elytra with the Comstock wing vein nomenclature, and the wing areas of Snodgrass.

Snodgrass divides the insect wing into four areas: axillary region, remigium, vannus and jugum. He defines three folds which serve as landmarks: (1) the basal fold from attachment of costa and subcosta to the first axillary sclerite, by the attachment of the radius to the second axillary sclerite, to the point of attachment of the vannal veins to the third axillary sclerite; (2) the vannal fold, which separates remigium from vannus; and (3) the jugular fold, which separates jugum from vannus, and has its base in the third axillary sclerite.

In these two elytra the four regions are very clearly defined. In plate 1, figures A and B the axillary region is illustrated. Figure B shows axillary sclerites 1 and 2 quite plainly, but the third axillary sclerite was still covered by the matrix. This was later removed and figure A, shows clearly the third axillary sclerite and its relationship to the marginal rim. The basal fold is the deep depression at the base of the elytra proper, separating the disc or remigium from the axillary sclerites. The entire disc, except the outer flattened margin is the remigium. The vannal fold is rather clearly shown in figures A and C, and internally is represented by the internal plica, which terminates at about the point where the fossil wing is broken. The vannus is then the flattened rim, and contains two very closely placed striae. The outer edge represents the jugular fold, and the inflexed lateral piece, the jugum. These terms may prove very useful in our descriptive work.

In thinking over the characters of the beetle elytron a rather striking thought came, concerning which the writer has never seen any statement. In the Orthoptera, Hemiptera, Diptera, Lepidoptera, Hymenoptera, etc., when the wings are in repose, the costal margin, which is the front edge when in flight, lies at the side of the body, and the anal or vannal portion is dorsal or dorso-medial. This is also true of the hind wings of Coleoptera. But, in the elytra an entirely different arrangement exists, which probably accounts for the uselessness of beetle elytra for flight.

The axillary pieces, which are normally pleural and hence lateral, have migrated dorsally on the mesothorax, and lie close to the scutellum. This brings the costal margin to the edge of the scutellum. The normal dorsal portion of the beetle elytron is the concave inner portion when the elytra are closed; and the normal ventral portion has become the convex outer side of the elytra. They fit closely together, and function in most beetles as a body covering, and in many species have become connate. This explains how the costa of beetle elytra is median, and the costa of beetle wings is lateral. Hence when one finds a fossil with the costal margins of two wings arising close to the same point and on the same side of the two wings, the insect is not Coleopterous. This was the deciding point on one of the fossils to be described in this series.

Correlation of the striae with the Comstock venation nomenclature was settled by several fixed points.

The costal vein is diagonal and cuts off a tiny basal triangle called humeral plate by Snodgrass (note the diagonal streak on figure B), but it is in the beetle elytron no longer humeral. We might more aptly call it precostal plate. The hardened sutural margin may be called the costal margin. The first stria, called scutellar stria by Casey, is the subcosta; a short vein of a few punctures (8 in the fossil, 14 in *bifossulatum)*, and does not make a cell with the next vein. Basally the interval between scutellum and subcosta is the costal interval; and between subcosta and radius, the subcostal interval. Beyond the end of the short subcosta, the interval adjoining the suture must be known as the costal-subcostal interval. The radius has a short basal stem and divides into two longitudinal veins, radius I and II (striae 2, 3), and the interval between them is then the first radial interval, and that following radius II the second radial interval. In *B. bifossulatum* the striae are clear throughout. In the fossil the apex is shining and the striae are very dim but discernible, and conform exactly with the *bifossulatum* pattern. Radius I and II are apically united, making a closed cell of the first radial interval. The third complete longitudinal vein (stria 4) is unquestionably medius I. There are two deep punctures in the second radial interval (third discal interspace), practically in the depression of medius I. These occupy different positions in the two species. All of these veins are definitely from the anterior stem. The fourth longitudinal vein (stria 5) is unattached at base, and opposite the third axillary sclerite, but slightly turned toward medius I, and may be considered as medius II. These two veins in *bifossulatum* are united before the apex to form a closed first median cell. This is dimly visible in the fossil. Opposite the transverse portion of the basal margin are three veins (striae 6, 7, 8) beyond medius II. The first is in *bifossulatum* attached to the basal margin, and is hence cubitus I, the second and third are cubitus II and postcubitus. The intervals following medius II, cubitus I and II and postcubitus are the second medial, first and second cubital and postcubital. In *bifossulatum,* and faintly in the fossil, cubitus I is subapically united with medius I and II, thus closing second median cell. Cubitus then extends to the apex a short distance from the junction of radius I and II. This makes the second radial interval an apically open cell with narrowly truncate apex and subapical lateral prong. Cubitus II and postcubitus terminate before the apex, and their intervals are open behind. The entire area just described constitutes the remigium.

The basal margin is the anal stem, and the lateral margin is flattened at the vannal fold to form a broad rim in which lie the first and second anal or vannal veins (striae 9, 10). These unite shortly before the tip, and in *bifossulatum* the extension unites with the terminus of cubitus I. In the fossil it is the same, though very faint.

The inflexed side piece of the elytra corresponds to the jugum, with the jugular fold the dorso-lateral margin of the elytra. The posterior termination of the jugular region makes a slight notch in the margin. Internally the vannal fold is prominent and is known in Carabid literature as the internal plica. It forms a groove to lock the abdomen.

BEMBIDION (OCHTHEDROMUS) DAVIDAE, new species

Plate 1

Described from a left elytron found imbedded in Upper Lower Miocene shale, Cuyama River outcrop section on the west bank of the river, near its junction with Huasna Creek, in San Luis Obispo County near center of section 27, Township 11 N, R. 33 W. San Bernardino Base Line and Meridian; in a part of the Saucesian formation, rich in foraminifera, indication of great depth; and sent in by Dr. Lore Rose David, paleontologist of the Richfield Oil Co., in whose honor the species is named. Holytype in Los Angeles County Museum of History, Science and Art, Paleontology No. S9001, and registered by the Museum under A4356.

The specimen is in unusually fine condition, with two cracks in the chitin, and the end of the elytron broken off, but present in slightly changed position. It is a very delicate specimen. Color brown, pale at tip.

Length 3.65 mm.; greatest width 1.43 mm.; sides subparallel in middle zone, gently convex to base and apex, with humeral

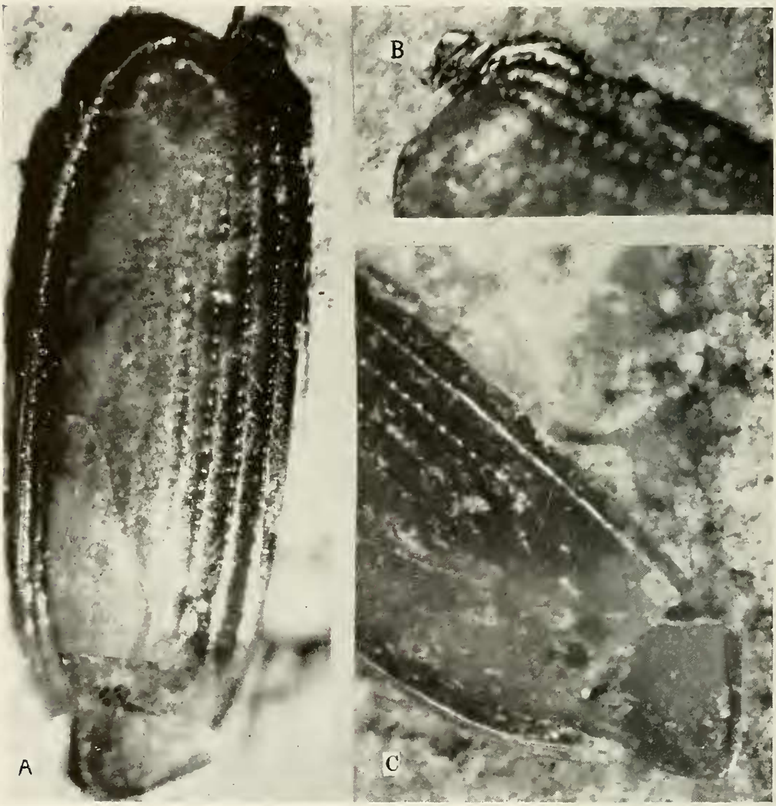

PLATE 1

Bembidion (Ochthedromus) davidae sp. nov., enlarged x approx. 29, Type
A. Entire elytron. B. Base. C. Apex.
Photo courtesy L. A. County Museum

angles rounded; marginal ridge beginning quite near the third axillary sclerite, at a point opposite the beginning of the sixth or cubital stria. In detail the elytron shows a strongly striato-punctate radio-medial area, and an almost smooth, faintly punctate cubital area, with all striae except the marginal, ones almost obliterated, very faintly impressed in the apical area. The two foveae characteristic of the genus are on the fourth stria, or medius I; the anterior fovea at about the basal third of the elytron; and the posterior at about the apical fourth. The basal sclerites are well defined, and form the elytral condyles. The very short costa cuts off a tiny basal precostal triangle (Snodgrass' humeral plate, but on beetle elytra no longer humeral), but the extended costal or sutural margin is sharply rimmed. The subcosta, or scutellar stria (stria 1) is short, not reaching the basal third, and consists of 8 punctures, in a deep stria. The two radial striae (striae 2, 3) are briefly united at base, deeply impressed, with coarse punctures to apical fourth, the first extending as a depression to the obtuse angled apex, where it joins the faint second radial stria. The punctation of radius II terminates a little beyond the second fovea, beyond which the impression is very faint. Medius I (stria 4) is deeply punctate to the second fovea. The first fovea intrudes upon the second radial interspace. Stria 5 which is interpreted as medius II is unattached at base, deeply punctate, but with punctures becoming obsolete before the apical third. Striae 6, 7 and 8 (interpreted as cubitus I and II and postcubitus are unattached at base, very faintly impressed, with minute faint punctures, and the entire area is quite smooth and shining. The vannal fold is parallel with the margin and sets off the flattened marginal ledge, on which are striae 9 and 10, which become clearly separated in the posterior half, and are closely deeply punctate. The inflexed lateral area, or jugum, begins at the humerus to become wider and is widest opposite the first fovea, thence narrows to the subapical notch.

When the smooth apical area is viewed in the correct light it can be seen that all striae are faintly impressed to the apex in exactly the same pattern as described for *bifossulatum* in the introductory note; that is, with radius I and II apically united; medius I and II and cubitus I subapically united; second radial interval subapically clubbed and apically narrowly open; cubitus I united with vannus I.

Viewed under high magnification, the surface is finely transversely, reticulately striate; and the punctures of subcosta, radius I and II, and medius I and II to the apical fourth are each provided with a tiny, transparent, white scale-like seta arising from the center of the puncture. These are very hard to see, except under just the right light, because they glisten in the light. The light spots in the punctures shown in the figures are due to the lights caught by these setae.

3. DESCRIPTION OF A DEEP WELL LOWER MIOCENE CARABID BEETLE

A section of oil well core, from 10,450 ft. depth in Miocene oil shale, containing two beetle elytron fragments was examined some time ago by the writer, but at that time he could not place it. The better specimen described in the foregoing article gave a clue to its systematic position, and consequently the specimen is being described as a second species of Bembidion in honor of Miss Jane Everest, paleontologist, the owner and donor of the type material.

It is believed that this fossil insect was the deepest of any yet found.

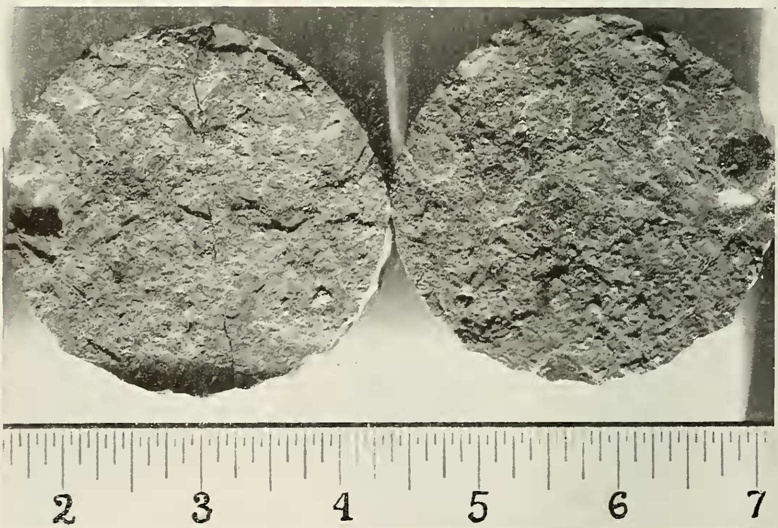

PLATE 2

Section of oil well core with *Bembidion everestae* in situ.
Photo courtesy L. A. County Museum

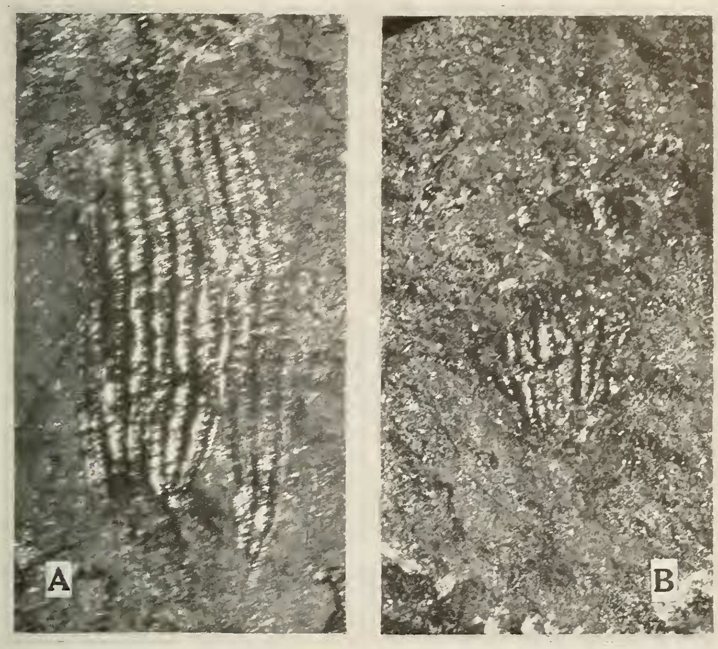

PLATE 3

Bembidion everestae n. sp. enlarged X approx. 1½.
A. Type, elytron. B. Fragment, perhaps tip of the same elytron.
Photo courtesy L. A. County Museum

BEMBIDION EVERESTAE, new species

PLATES 2, 3

Described from a fragment of an elytron, and its impression in oil shale core (Plate 2) from oil well boring of the Ohio Oil Co. well K.C.L.-G.No.1, in the Bellevue District, near town of Rosedale, 6 miles due west of Bakersfield, Kern Co., California, location 2310.1′ S. and 1639.75′ E. of N.W. corner of Section 36, 29 S./26 E. Monte Diablo B. & M., elevation 373.3, taken at depth of 10,450 ft. The formation is Upper Lower Miocene, Saucesian Age. Registered at Los Angeles Museum of History, Science and Art under A4709, Paleontology No. S9003.

The specimen (Plate 3) was crushed and apically split, and the basal margin of the elytron is missing. On account of the peculiarly distorted zone on the first radial interspace corresponding to the puncture usually found at this point in Bembidion, the species is assigned to that genus. The species differs greatly from *Bembidion davidae* in that all striae are deeply impressed and coarsely punctate throughout, and with considerable irregularity at the first fovea. This is found in the first subgenus in Casey's key, *Odontium* LeConte, to which we may tentatively assign it.

Length 4.92 mm. by 2.46 mm.

The costal and subcostal zone, as well as the axillary sclerites, are not visible. The first radial stria extends the entire length of the elytron, where it is met by radius II. The first fovea lying slightly beyond the basal third is in the line of the third visible stria, medius, I, which is broken to form an oval ring around the foveate area. The presence of this foveate area slightly changes the course of radius II and medius II. The elytron is split from about the apical third, between medius I and medius II. The cubito-vannal area contains six punctate striae, cubitus I and II, postcubitus, and vannus I , II and III, the last rather indistinct. Vannus I probably coincides with the vannal fold. As described in article 2, medius II, cubitus I and II are apically united, but the terminus of the cubital and vannal veins is missing. The vannal area forms quite a wide lateral ledge, much wider than in *davidae*.

Five eighths of an inch from the above described specimen is a tiny fragment, probably of the tip of an elytron, perhaps of the same specimen, because it is of the same sculpture. It is illustrated in figure B.

4. TWO INTERESTING ORTHOPTEROIDS FROM DIATOMACEOUS DEPOSITS

In this paper a new source of insect fossils is introduced, and if the evidences on the two pairs of slabs is any indication, careful study after the war should reveal more fossil insects. On one pair of slabs there are, in addition to the wing described, fragments of two other kinds of wings.

The specimens were found by Robert K. Foster, and presented to the Cabrillo Beach Marine Museum of the Department of Playground and Recreation of the City of Los Angeles. Dr.

W. L. Lloyd, Director of the Museum, on learning that the insect remains were new to science, consented to their description and deposit in the type collection of the Los Angeles County Museum.

Dr. Chester Stock, Paleontologist of the Los Angeles County Museum, visited the site with Dr. Lloyd, and described it as a cliff of diatomaceous shale located approximately 100 feet south of an abandoned navy pier at Fort MacArthur lower reservation, approximately 3100 feet directly north of the breakwater at San Pedro, Los Angeles County, California. The specimens occur in Valmonte diatomite of the Monterey Shale, Upper Miocene.

The two insects described below represent new genera, one definitely Orthopteran, the other doubtfully so. It has very primitive characters, with certain Orthopteran features, and also certain resemblances to Coleoptera and Diptera, but cannot belong to either of these.

PROTOSEGESTES, new genus

Tettigoniidae, with wing tegmen of the shape found in *Segestes* of the Mecopodinae. Strong humeral plate; broad almost parallel costal area to apical third; costal area terminating or merging with radius at about apical fifth; radius deeply impressed; true remigial area apically acute; vannal area narrowly elongate, triangular; jugal fold at right angles to radial fold. Surface entirely reticulate, with small longitudinal cells.

Type of genus—*Protosegestes lloydi* Pierce

PROTOSEGESTES LLOYDI, new species

PLATE 4

Fossil in Upper Miocene, Monterey shale, Valmonte diatomite. Described from inner side of a tegmen and its impression, found by Robert K. Foster, and deposited by Dr. William L. Lloyd, Director of the Cabrillo Beach Marine Museum, and a Director of the Southern California Academy of Sciences, accessioned by Los Angeles County Museum under L2063, and recorded in the Paleontology Department as S9004.

Length 57.5 mm.; greatest breadth 10.5 mm.; length from costal shoulder to end of costal area 47.5 mm.; length from jugal fold to apex 53 mm.; length of vannal fold 20 mm. An elongate, strongly reticulate wing with acute apex, strong humeral plate,

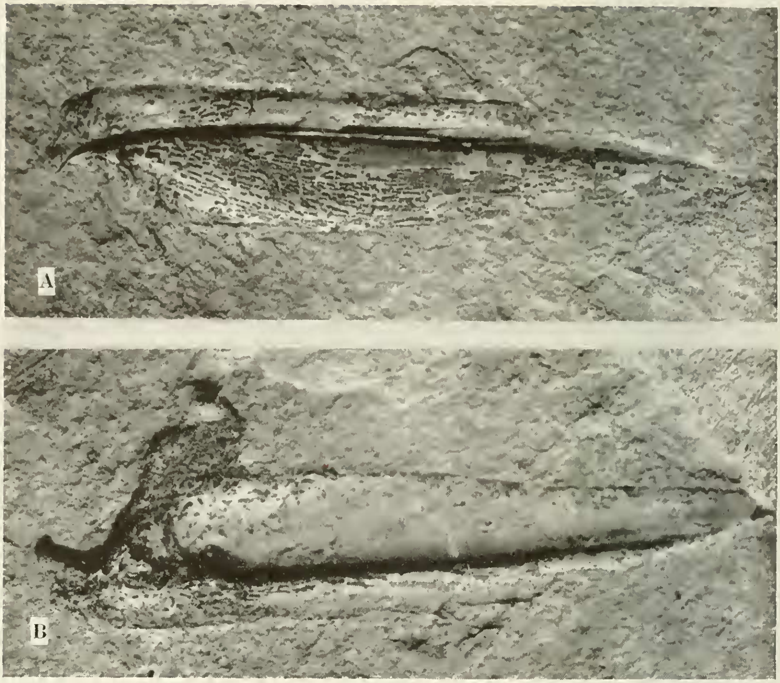

PLATE 4

Protosegestes lloydi n. sp. enlarged x approx. 1⅓.
A. Front wing, inner surface, Type. B. Reverse impression of above.
Photo courtesy L. A. County Museum

broad subparallel costal area. Axillary region of first and second axillae strong, beak like. The wing proper is in reality divided into four areas, for the remigium of Snodgrass is sharply divided by a deep fold along radius, and we may call the outer portion which clasps the body the costal area, and the radio-medio-cubital area the true remigium. The vannal fold is diagonal, separating the smaller vannal or anal area; and a small jugal area is set off by a deep jugal fold. As in other Orthoptera the third axilla is below and beyond the other two.

J. H. Comstock, in The Wings of Insects, considers the costa in Orthoptera to be absent or rudimentary, but following Snodgrass, we may detect a small triangular basal or shoulder area set off by a short diagonal costa; and this area is known as the humeral plate. The costal margin then extends to the end of the costal area at the apical fifth of the wing. This area is broadest at the junction of the costa with the outer margin, but is almost parallel thence to the radial fold up to the apical third of the wing, and thence is narrowed to its apex. The costal area is reticulately covered with longitudinal cells.

The deep radial fold includes basally the subcosta and radius. Subcosta becomes differentiated at about the middle of the wing, when it enters the costal area. The remigium proper is broken up into a net work of short longitudinal cells in such manner that it is impossible to differentiate the radial, medial and cubital veins. The area is broadest at the apex of the vannal fold, and rapidly narrows to an acute point at the tip of the wing. It is this acutely tipped wing which suggests relationship to the Philippine Segestes. The vannal area is a long, narrow triangle based in the deep jugal fold close to the radial fold, and extending almost to the middle of the entire wing; but measuring from vannal fold to apex of the wing, it only reaches to the basal third of this length. The vannal area is also filled with small, longitudinal cells. The jugal area is a small flap-like area separated by the deep jugal fold.

EXAERETOPTERA, new genus

Name based on 'ΕΞΑΙΡΕΤΟΣ—picked out, chosen, peculiar, rejected, + ΠΤΕΡΟΝ—wing.

Type of new family, EXAERETOPTERIDAE, and new superfamily (or order ?) EXAERETOPTEROIDEA, placed tentatively in Orthoptera.

Four-winged insects, with fore wings shorter than the hind wings. Fore wing, or tegmen, with broad costal area, extending entire length of wing, and with a broad jugal (?) area extending far beyond the apex of the cubital cell. Subcosta and radius united to middle; medius basally united with cubitus, and beyond cubital cell, with but a single branch.

Type of genus *Exaeretoptera fosteri* Pierce

EXAERETOPTERA FOSTERI, new species

PLATES 5, 6

Fossil wings in Upper Miocene, Monterey shale, Valmonte diatomite. Described from inside of tegmen and fragment of hind wing, and the corresponding impression; found by Robert K. Foster, and deposited by Dr. William L. Lloyd, Director of the

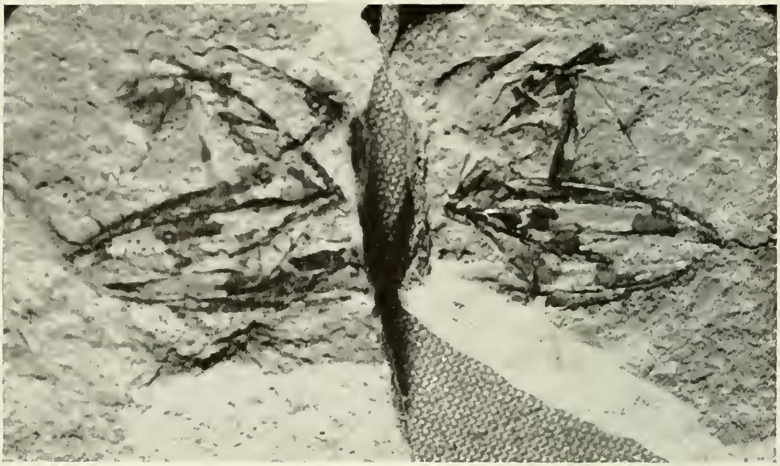

PLATE 5

Exaeretoptera fosteri n. sp. enlarged X 2.
Type on left; opposing impression on right.
Photo courtesy L. A. County Museum

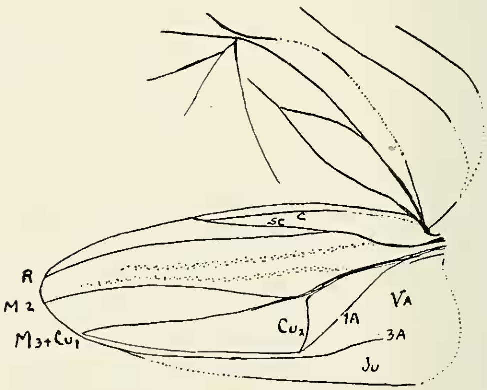

PLATE 6

Interpretation of venation of type.
Author's figure.

Cabrillo Beach Marine Museum; accessioned under L2063, and recorded in the Paleontology Department as S9005.

These wings do not fit well into any order of recent or fossil insects, but are to be considered as Orthopteroid, because of the broad costal area and strong jugal area, which is unusually long in the tegmen. The fan-like branching of veins at the middle of the hind wing does not seem comparable to any described insect.

Length of tegmen, or anterior wing 18 mm.; greatest breadth 9 mm. Wing surface thin, brown, parchment-like with heavy brown veins. The costa cannot be traced at base, but is seen in its extension to the point of merging with subcosta. Radius and subcosta are united at base, and strongly curved, subcosta departing at crest of curve, and diagonally crossing the broad costal area. Radius is unbranched, but a depression probably indicates the radial sector, Medius, cubitus and first anal are united at base, first anal soon departing, and toward the middle of the wing cubitus 2 departs almost at right angles to form a triangular cubital cell with the first anal. Shortly beyond this cell there is a branching, the upper vein being medius 2 and the lower medius 3 + cubitus 1, both veins continuing to the apex of the wing. A depression above the medio-cubitus, which arises about the middle of the cubital cell, may indicate the course of medius 1. From the apex of the cubital cell, cubitus 2 + first anal continues along the margin of the remigium to form junction at the apex with medius 3 + cubitus 1. The triangular cubital cell is the real landmark of this wing, which identifies the surrounding veins. This cell is a common feature of Dipterous wings, and also occurs in Orthopteran fore wings. A short vein from base is probably second anal. The origin of third anal is missing, but this vein extends beyond the apex of the cubital cell close to the cubitus 2 + first anal, and becomes the marginal vein of the wing toward apex, beyond the point where the jugal margin joins it. The broad area below this is interpreted as the jugum. The only example of a jugum extending in this manner, known to the author is in the Coleoptera, Carabidae, where it is infolded.

The third wing offers too many problems for one to venture its description. Characteristic of the fragment are the broad marginal and costal areas, a basal cell in the radio-medial area and a fanning of veins at perhaps the middle of the wing. The distance from base to this fan is 13 mm., and we may assume that the wing approximates 26 mm. in length. Although the texture of the two wings is the same, it is possible that the two did not belong to the same insect.